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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR		ATTORNEY DOCKET NO.
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EXAMINER	
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ART UNIT	PAPER NUMBER
2763	15

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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.	Applicant(s)
08/889,440	Takeuchi et al.
Examiner	**Group Art Unit**
Hugh Jones	2763

[X] Responsive to communication(s) filed on *Feb 9, 1999*

[ ] This action is **FINAL.**

[ ] Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle* 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire ___3___ month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

- [X] Claim(s) *1-32* is/are pending in the applicat
  - Of the above, claim(s) ______ is/are withdrawn from consideration
- [ ] Claim(s) ______ is/are allowed.
- [X] Claim(s) *1-32* is/are rejected.
- [ ] Claim(s) ______ is/are objected to.
- [ ] Claims ______ are subject to restriction or election requirement.

Application Papers

- [ ] See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.
- [ ] The drawing(s) filed on ______ is/are objected to by the Examiner.
- [ ] The proposed drawing correction, filed on ______ is [ ] approved [ ] disapproved.
- [ ] The specification is objected to by the Examiner.
- [ ] The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- [X] Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
  - [X] All [ ] Some* [ ] None of the CERTIFIED copies of the priority documents have been
    - [X] received.
    - [ ] received in Application No. (Series Code/Serial Number) ______.
    - [ ] received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
  - *Certified copies not received: ______
- [ ] Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- [X] Notice of References Cited, PTO-892
- [ ] Information Disclosure Statement(s), PTO-1449, Paper No(s). ______
- [ ] Interview Summary, PTO-413
- [ ] Notice of Draftsperson's Patent Drawing Review, PTO-948
- [ ] Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

DETAILED ACTION

Claim Rejections - 35 USC § 101

1. **Claims 20-22 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.** The applicant is attempting to claim an algorithm, specifically a simulation algorithm. It is not clear what constitutes the end use of the invention, as per claims 20-22. As per remarks (pg. 6 of paper # 8) concerning tangible results; what is the useful result of simulating phenomena of a "combined particle"? These claims represent abstract ideas without any useful application.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. **Claims 1-32 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.**

4. As per claims directed at "combined particles" (claims 1-32), Examiner has reviewed pp. 31-33 of the specification. The specification only describes the composition of the combined

particles; but, does not describe how the components of the combined particle are combined. The meaning is not clear especially in light of Applicant's various comments. Therefore, Examiner requires a copy of Applicant's software package so that Examiner can determine what constitutes "combined".

5. As per claims 6, 8, and 29, wherein "...indicating whether the smaller particles of a respective individual particle are fixed against center of mass of the individual particle...", it is still not clear what the individual particles and smaller particles are. Under one assumption, the individual particle is a cluster or some similar entity of adsorbate particles and the smaller particles are individual adsorbate particles (the cohesive forces would have to be greater than the kinetic energies of the individual particles [and which I assume are significant since they are being generated" and must have enough momentum to reach the substrate]). No mention has been made concerning clusters in the specification. On the other hand, if the individual particle is on molecule or ion, then the smaller particles refer to electrons, etc. Of course in the case of electrons, they are not fixed with respect to the center of mass of the larger particle.

6. As per claim 27, wherein "...each substrate particle includes a fixed particle, a temperature control particle and a free particle...", it is not clear how a substrate particle can include a free particle since by definition a substrate particle is connected to a lattice. The meaning is still not clear especially in light of Applicant's various comments.

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 1-3, 5-6, 8-10, 12, 15-18, 20-23, and 29 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

9. A number of claims were found to be indefinite because they contained terms which were unclear in their meaning.

10. As per claims 1-3, 5-6, 8-10, 12, 15-18, and 20-23, it is not clear what the terms "combined particle" and "individual particle(s)" means with respect to the following. This is evident from examination of claims 1 and 2. In claim 1, the following is stated, "...a combined particle formed of individual particles; however, in claim 3, the following is stated, "wherein the combined particle is formed of substrate particles and adsorbate particles, each said individual particle being an adsorbate particle." Is a combined particle formed of individual particles, where by definition, the individual particles are adsorbate particles, or is the combined particle is formed of substrate particles and adsorbate particles. It is also unclear what is meant by "combined particle." <u>The issue is still not resolved, and the rejection is reasserted.</u>

11. As per claim 29, wherein, "...each adsorbate particle includes a plurality of smaller particles...", it is not clear from the claims what this means. Is it an absorbate particle in the sense of the combined particle" and the smaller particles are individual absorbate particles, or is it an individual absorbate particle wherein the smaller particles are the electrons, ions, etc.?

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. As noted above and during prosecution of this case, there exist issues concerning the Applicant's definitions of terms such as individual particle, combined particle, smaller particle, etc. The examiner has examined the merits of the claims based on the the most reasonable interpretation of those terms.

14. In general, the applicants are disclosing method and apparatus to simulate physical interaction of (in the more narrow claims) adsorbates and a substrate. There is an abundance of publications concerning this topic as well as animated display of such simulations. The Applicant has emphasized the concept "*combined*" throughout the claims; if there is special significance to this term (such as a new interpretation pertaining to the underlying physical interactions between particles), it is not supported by the specification. The prior art rejections will be based on the examiner's interpretation of the specification and claims.

15. **Claims 1-32 are rejected under 35 U.S. C. 103 (a) as being unpatentable over Misaka et al. in view of Baumann et al., the Examiner's own experience and the taking of Official Notice.** The full rejection (which is essentially the original rejection, modified to take into

account Applicant's amendment) is presented in full for Applicant's benefit. This is followed by new art rejections, which are presented separately, in order to avoid confusion.

16. Misaka et al. disclose a dry-etching process simulator wherein a surface reaction model is used to simulate topological evolutions by taking into account the existence of adsorbed radicals on the substrate surface. Misaka et al. apparently do not mention "combined particles". Baumann et al. disclose 3D modeling of sputtering using a mesoscopic hard-sphere Monte Carlo model. This work is included because Baumann et al. go further than Misaka et al. as pertains to combined particles" (see fig. 1 of Baumann et al.). Baumann et al. simulate the behavior of clusters as they interact with a substrate (note that the use of ion cluster beams and molecular beams for deposition and/or sputtering are well known techniques; this phenomena has also been simulated.). Not all details of the applicant's disclosure are present in these two inventions; however, both could easily be used to obtain results concerning the physical phenomena which the applicant is interested in. Both sets of inventors are concerned with the simulating the dynamics of particles which are interacting with a substrate during processing of the substrate. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the two works. The claims are reviewed and the contributions by each inventor, as outlined above, are noted.

17. **As per claim 1, this is concerned with an apparatus for simulating phenomena of a combined particle formed of individual particles,** (Misaka et al.: figs. 1, 2, 3b, 4), **comprising: a kinetic condition setting unit** (this is inherent in particle simulators such as monte Carlo

simulators) **which sets information for defining a plurality of generation periods and a corresponding number of individual particles to be generated during each generation period** (Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"); col. 2, lines 29-34 and 49-59; Baumann et al.: pg. 4.4.1)**; and**

a particle motion computing unit which generates the individual particles in accordance with the information set by the kinetic condition setting unit and computes motion of the generated individual particles, to simulate phenomena of the combined particle, each individual particle having a corresponding emission source (again, this is inherent in particle simulators such as Monte Carlo simulators; Misaka et al.: abstract; fig. 1,2; col. 2 lines 49-59 and 59-64; col. 3, lines 3-68; col. 4, lines 1-6; Baumann et al.: pg, 4.4.1).

18. As per claim 2, this is concerned with an apparatus as in claim 1, wherein the combined particle is formed of substrate particles and adsorbate particles (Misaka et al.: abstract; figs. 1, 2, 3b, 4; col. 1, lines 35-68; col. 3, lines 16-68; col. 4, lines 50-65; Baumann et al. fig. 1).

19. As per claim 3, this is concerned with an apparatus as in claim 1, wherein the combined particle is formed of substrate particles and adsorbate particles, each said individual particle being an adsorbate particle (Misaka et al.: abstract; figs. 1, 2, 3b, 4; col. 1, lines 35-68; col. 3, lines 16-68; col. 4, lines 50-65; Baumann et al.: inherent in fig. 2)**, and,**

before generating the individual particles, the particle motion computing unit generates the substrate particles (this would seem to be obvious; why generate particles which

are to interact with a target if the target is not there; Misaka et al.: figs. 1, 2, 4, 5, 7, 8b, 9, 10; Baumann et al.:

fig. 1).

20. **As per claim 4, this is concerned with an apparatus as in claim 1, further comprising:**

a display which allows a user to enter the information set by the kinetic condition setting unit (this is standard with respect to particle simulators in general. I have personally done this as it pertains to Monte Carlo simulations).

21. **As per claim 5, this is concerned with an apparatus as in claim 1, wherein the combined particle is formed of a first type of particle and a second type of particle, each of said individual particles being the first type of particle** (Misaka et al.: abstract; figs. 1, 2, 3b, 4; col. 1, lines 35-68; col. 3, lines 16-68; col. 4, lines 50-65; Baumann et al. -. fig. 1; pg. 4.4.1), **and**

the kinetic condition setting unit sets information for generating the second type of particle (obviously, this information must be provided for each species; Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"),- col. 2, lines 29-34 and 49-59, Baumann et al.: pg. 4.4.1)

22. **As per claim 6, this is concerned with an apparatus as in claim 1, wherein each individual particle is formed of smaller particles** (Misaka et al.: fig. 1 ("radical"), fig. 2, fig. 4 (b,c,d); Baumann et al. - fig. 1; pg. 4.4.1);

the information set by the kinetic condition setting unit includes information indicating whether the smaller particles of a respective individual particle are static against center of mass of the individual particle (this limitation is not addressed due to the 112 issues raised); **and**

when the particle motion computing unit generates an individual particle and the information set by the kinetic condition setting unit indicates that the smaller particles of the respective individual particle are not static against the center of mass, the particle motion computing unit provides a random orientation to the smaller particles of the individual particle (Official notice is taken that this physical phenomena and approximations so as to take it into account in simulations were well known in the art at the time of the invention. [see for example studies of ion attachment to electrodes submersed in salt solutions, studies of nucleation, or the motion of electrons around moving atoms or molecules]).

23. **As per claim 7, this is concerned with an apparatus as in claim 6, further comprising:**

a display which allows a user to enter the information set by the kinetic condition setting unit (this is standard with respect to particle simulators in general. I have personally done this as it pertains to Monte Carlo simulations).

24. **As per claim 8, this is concerned with an apparatus as in claim 1, wherein each individual particle is formed of smaller particles** (Misaka et al.: fig. 1 ("radical"), fig. 2, fig. 4 (b,c,d); Baumann et al.: fig. 1; pg. 4.4.1),

the information set by the kinetic condition setting unit includes information indicating whether the smaller particles of a respective individual particle are static against center of mass of the individual particle (this limitation is not addressed due to the 112 issues raised), **and**

when the particle motion computing unit generates an individual particle and the information set by the kinetic condition setting unit indicates that the smaller particles of the respective individual particle are not static against the center of mass, the particle motion computing unit provides an initial velocity to the smaller particles of the individual (I assume the applicant is talking about molecules here? [in which case the parts of the molecule interact with each other via vibrational modes, and thus are not bound]) **particle** (Official notice is taken that this physical phenomena and approximations so as to take it into account in simulations were well known in the art at the time of the invention. [see for example studies of ion attachment to electrodes submersed in salt solutions, studies of nucleation, or the motion of electrons around moving atoms or molecules]).

25. **As per claim 9, this is concerned with an apparatus as in claim 1, wherein, when generating an individual particle, the particle motion computing unit provides a random direction within a cone pointed at the substrate and being centered at a point of generation of center of mass velocity of the individual particle** (this is inherent in particle simulations in general, and in Monte Carlo simulations, in particular [see for example studies of gaseous

discharges wherein an electron is emitted from a cathode or an electron is ejected from an atom due to collisional ionization]).

26. **As per claim 10, this is concerned with an apparatus as in claim 1, wherein**

for each individual particle, the kinetic condition setting unit sets a region indicating a position of the corresponding emission source (Misaka et al.: fig. 1, # 15; also inherent in figs. 2, 7, 8b, 10; Baumann et al.: inherent in fig. 1), and

the particle motion computing unit generates each individual particle in accordance with the position of the corresponding emission source (Misaka et al.: fig. 1, # 15; Baumann et al.: inherent in fig. 1).

27. **As per claim 11, this is concerned with an apparatus as in claim 1, further comprising a display which displays the information set by the kinetic condition setting unit** (this is standard with respect to particle simulators in general. I have personally done this as it pertains to Monte Carlo simulations).

28. **As per claim 12, this is concerned with an apparatus for simulating phenomena of a combined particle formed of individual particles, each individual particle having a corresponding emission source, the apparatus comprising:**

an input device which allows a user to designate a region (this is standard with respect to particle simulators in general. I have seen done this as it pertains to Monte Carlo simulation [specifying the position of the cathode which is to eject electrons]; Misaka et al.: figs, 1, 5, 7, 8b, 9, 10- Baumann et al.: inherent in fig. 1);

a kinetic condition setting unit which, for each individual particle, sets the region designed by the user as a region indicating a position of the corresponding emission source (Misaka et al. fig. 1, # 15; Baumann et al.: inherent in fig. 1); **and**

a particle motion computing unit which generates the individual particles in accordance with the position of the corresponding emission source as indicated by the region designated by the user and computes motion of the generated individual particles, to simulate phenomena of the combined particle (Misaka et al.: fig. 1, # 15; fig. 5 - Baumann et al.: pg. 4.4.1).

29. **As per claim 13, this is concerned with an apparatus as in claim 12, wherein the input device is a display** (this is standard with respect to particle simulators in general. I have personally done this as it pertains to Monte Carlo simulations).

30. **As per claim 14, this is concerned with an apparatus as in claim 12, further comprising a display which displays the information set by the kinetic condition setting unit** (this is standard with respect to particle simulators in general. I have personally done this as it pertains to Monte Carlo simulations).

31. **As per claim 15, this is concerned with an apparatus as in claim 14, wherein the display shows the individual particles generated by the particle motion computing unit and indicates the motion computed by the particle motion computing unit** (this is standard in the art; I have seen this type of display at conferences [Official notice is taken that this feature was well known in the art at the time of the invention.).

32. **As per claim 16, this is concerned with an apparatus for simulating phenomena of a combined particle formed of individual particles, comprising:**

a kinetic condition setting unit (this is inherent in particle simulators such as monte Carlo simulators) **which sets information for defining kinetic conditions of the individual particles** (Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"); col. 2, lines 29-34 and 49-59; Baumann et al.: pg. 4.4.1); **and**

a particle motion computing unit which generates the individual particles in accordance with the information set by the kinetic condition setting unit and computes motion of the generated individual particles, to simulate phenomena of the combined particle, each individual particle having a corresponding emission source (again, this is inherent in particle simulators such as Monte Carlo simulators; Misaka et al.: abstract; fig. 1, 2 col. 2 lines 49-59 and 59-64; col. 3, lines 3-68; col. 4, lines 1-6; Baumann et al.: pg. 4.4.1).

33. **As per claim 17, this is concerned with an apparatus as in claim 16, wherein**

the combined particle is formed a first type of particle and a second type of particle, the first type of particle moving towards the second type of particle, each of said individual particles being the first type of particle (Misaka et al. - fig. 1, 2, 3b; Baumann et al.: fig. 1),

the kinetic condition setting unit sets a region for defining an initial position of the individual particles (Misaka et al.: figs. 1, 5; Baumann et al.: inherent on pg. 4.4.1),

the apparatus further comprises a display which displays the relationship between the region set by the kinetic condition setting unit and a region indicating a position of a

second type of particle forming the combined particle (this is standard in the art; I have seen this type of display at conferences [Official notice is taken that this feature was well known in the art at the time of the invention.]).

34. **As per claim 18, this is concerned with an apparatus as in claim 17, wherein**

the kinetic condition setting unit sets information for providing a direction of velocity to the individual particles (Misaka et al.: fig. 1 # 15; Baumann et al.: inherent on pg. 4.4.1), **and**

the display shows the direction of velocity with respect to the region set by the kinetic condition setting unit and the region indicating the position of the second type of particle (this is standard in the art; I have seen this type of display at conferences [Official notice is taken that this feature was well known in the art at the time of the invention.]).

35. **As per claim 19, this is concerned with an apparatus as in claim 16, further comprising a display which displays the information set by the kinetic condition setting unit** (this is standard with respect to particle simulators in general. I have personally done this as it pertains to Monte Carlo simulations).

36. **As per claim 20, this is concerned with a computer-implemented method for simulating phenomena of a combined particle formed of individual particles, comprising the steps of:**

setting information for defining a plurality of generation periods and a corresponding number of individual particles to be generated during each generation period (Misaka et al.: fig. 1, # 15; Baumann et al.: inherent on pg. 4.4.1);

generating the individual particles in accordance with the information set in the setting step (Misaka et al.: fig. 1, # 15; Baumann et al.: inherent on pg. 4.4.1), **and**

computing motion of the generated individual particles, to simulate phenomena of the combined particle (again, this is inherent in particle simulators such as Monte Carlo simulators, Misaka et al.: abstract; fig. 1, 2; col. 2 lines 49-59 and 59-64; col. 3, lines 3-68; col. 4, lines 1-6; Baumann et al.: pg. 4.4.1).

37. **As per claim 21, this is concerned with a method as in claim 20, wherein the combined particle is formed of substrate particles and adsorbate particles, each said individual particle being an adsorbate particle** (Misaka et al.: abstract; figs. 1, 2, 3b, 4; col. 1, lines 35-68; col. 3, lines 16-68; col. 4, lines 50-65; Baumann et al.: fig. 1, inherent in fig. 2).

38. **As per claim 22, this is concerned with a computer-implemented method for simulating phenomena of a combined particle formed of individual particles, each individual particle having a corresponding emission source, the method comprising the steps of**

setting, for each individual particle, a region indicating a position of the corresponding emission source (this is standard with respect to particle simulators in general. I have seen done this as it pertains to Monte Carlo simulation [specifying the position of the

cathode which is to eject electrons]; Misaka et al.: figs, 1, 5, 7, 8b, 9, 10; Baumann et al.: inherent on pg. 4.4.1),

generating the individual particles in accordance with the position of the corresponding emission source as indicated by the region set in the setting step (Misaka et al.: fig. 1, # 15; Baumann et al.: inherent on pg. 4.4.1); and

computing motion of the generated individual particles, to simulate phenomena of the combined particle (Misaka et al.: fig. 1, # 15; Baumann et al.: pg. 4.4. 1).

39. As per claim 23, this is concerned with an apparatus for simulating phenomena of a combined particle formed of individual particles, comprising:

setting information for defining kinetic conditions of the individual particles;

displaying the set information (Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"); col. 2, lines 29-34 and 49-59; Baumann et al.: inherent on pg. 4.4.1);

generating the individual particles in accordance with the set information (again, this is inherent in particle simulators such as Monte Carlo simulators; Misaka et al.: abstract; fig. 1,2; col. 2 lines 49-59 and 59-64; col. 3, lines 3-68; col. 4, lines 1-6; Baumann et al.: inherent on pg. 4.4.1); and

computing motion of the generated individual particles, to simulate phenomena of the combined particle, each individual particle having a corresponding emission source (again, this is inherent in particle simulators such as Monte Carlo simulators; Misaka et al.:

abstract; fig. 1, 2; col. 2 lines 49-59 and 59-64; col. 3, lines 3-68; col. 4, lines 1-6; Baumann et al.: pg. 4.4.1).

40. **As per claim 24, this is concerned with an apparatus for simulating phenomena of a combined particle formed of substrate particles and adsorbate particles, comprising:**

a kinetic condition setting unit (this is inherent in particle simulators such as monte Carlo simulators) **which sets information for defining kinetic conditions of the adsorbate particles** (Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"); col. 2, lines 29-34 and 49-59; Baumann et al.: inherent on pg. 4.4.1), and

a particle motion computing unit which generates the adsorbate particles in accordance with the information set by the kinetic condition setting unit and computes motion of the generated adsorbate particles, to simulate phenomena of the combined particle, each adsorbate particle having a corresponding emission source (again, this is inherent in particle simulators such as Monte Carlo simulators; Misaka et al.: abstract; fig. 1,2; col. 2 lines 49-59 and 59-64; col. 3, lines 3-68; col. 4, lines 1-6; Baumann et al.: pg. 4.4.1).

41. **As per claim 25, this is concerned with an apparatus as in claim 24, wherein the information set by the kinetic condition setting unit** (this is inherent in particle simulators such as Monte Carlo simulators) **defines a plurality of generation periods and a corresponding number of adsorbate particles to be generated during each generation period by the particle motion computing unit** (Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"); col. 2, lines 29-34 and 49-59; Baumann et al.: inherent on pg. 4.4.1).

42. **As per claim 26, this is concerned with an apparatus as in claim 24, wherein the information set by the kinetic condition setting unit includes information for defining kinetic conditions of the substrate particles** (Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"); col. 2, lines 29-34 and 49-59; Baumann et al.: inherent on pg. 4.4.1); **and**

the particle motion computing unit generates the substrate particles before generating the adsorbate particles (this would seem to be obvious; why generate particles which are to interact with a target if the target is not there; Misaka et al.: figs. 1, 2, 4, 5, 7, 8b, 9, 10; Baumann et al.: pg. 4.4.1).

43. **As per claim 27, this is concerned with an apparatus as in claim 24, wherein**

each substrate particle includes a fixed particle, a temperature control particle and a free particle (this limitation is not addressed due to the 112 issues raised; [however, Baumann et al. does address the issue of temperatue: fig. 6]),

the information set by the kinetic condition setting unit includes information for defining kinetic conditions of the fixed particle, the temperature control particle and the free particle of each substrate particle (Misaka et al.: figs. 1, 2, 5 ("calculate fluxes"); col. 2, lines 29-34 and 49-59; Baumann et al.: inherent on pg. 4.4.1), **and**

the particle motion computing unit generates the fixed particle, the temperature control particle and the free particle of each substrate particle in accordance with the information set by the kinetic condition setting unit (again, this is inherent in particle

simulators such as Monte Carlo simulators; Misaka et al.: abstract; fig. 1,2; col. 2 lines 49-59 and 59-64; col. 3, lines 3-68; col. 4, lines 1-6; Baumann et al.: inherent on pg. 4.4.1).

44. **As per claim 28, this is concerned with an apparatus as in claim 24, further comprising a display which displays the information set by the kinetic condition setting unit** (this is standard with respect to particle simulators in general. I have personally done this as it pertains to Monte Carlo simulations).

45. **As per claim 29, this is concerned with an apparatus as in claim 24, wherein each adsorbate particle includes a plurality of smaller particles** (Misaka et al.: fig. 1 ("radical"), fig. 2, fig. 4 (b,c,d); Baumann et al. fig. 1);

the information set by the kinetic condition setting unit includes information indicating whether the smaller particles of a respective adsorbate particle are static against center of mass of the adsorbate particle (this limitation is not addressed due to the 112 issues raised); **and**

when the particle motion computing unit generates an adsorbate article and the information set by the kinetic condition setting unit indicates that the smaller particles of the respective adsorbate particle are not static against center of mass, the particle motion computing unit provides a random orientation to the smaller particles of the adsorbate particle (Official notice is taken that this physical phenomena and approximations so as to take it into account in simulations were well known in the art at the time of the invention. [see for

example studies of ion attachment to electrodes submersed in salt solutions, studies of nucleation, or the motion of electrons around moving atoms or molecules]).

46. **As per claim 30, this is concerned with an apparatus as in claim 29, wherein, when the particle motion computing unit generates an adsorbate particle and the information set by the kinetic condition setting unit indicates that the smaller particles of the respective adsorbate particle are not fixed against center of mass, the particle motion computing unit provides an initial velocity to the smaller particles of the adsorbate particle** (Official notice is taken that this physical phenomena and approximations so as to take it into account in simulations were well known in the art at the time of the invention. [see for example studies of ion attachment to electrodes submersed in salt solutions, studies of nucleation, or the motion of electrons around moving atoms or molecules]).

47. **As per claim 31, this is concerned with an apparatus as in claim 24, wherein, when generating an adsorbate particle, the particle motion computing unit provides a random direction of center of mass velocity of the adsorbate particle** (Official notice is taken that this physical phenomena and approximations so as to take it into account in simulations were well known in the art at the time of the invention. [see for example studies of ion attachment to electrodes submersed in salt solutions, studies of nucleation, or the motion of electrons around moving atoms or molecules]).

48. **As per claim 32, this is concerned with an apparatus as in claim 24, wherein**

for each adsorbate particle, the kinetic condition setting unit sets a region indicating a position of the corresponding emission source (Misaka et al.: fig. 1, # 15; also inherent in figs. 2, 7, 8b, 10; Baumann et al.: inherent on pg. 4.4.1), **and**

the particle motion computing unit generates each adsorbate particle in accordance with the position of the corresponding emission source as indicated by the region set by the kinetic condition setting unit (Misaka et al.: fig. 1, # 15; Baumann et al.: pg. 4.4.1).

New Art Rejections

Claim Rejections - 35 USC § 102

49. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

50. Claims 1, 12, 16, 20 and 22-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Reeves (1983) or Cohen (1992).

51. Reeves discloses animation of particle behavior and discloses the concept of combined particle. On page 91,

> *"First, an object is represented not by a set of primitive surface elements, such as polygons or patches, that define its boundary, but as clouds of primitive particles that define its volume."*

Section 2.1 discloses particle generation. Section 2.2 discloses:

"For each new particle generated, the particle system must determine values for the following attributes:

(1) initial position,

(2) initial velocity (both speed and direction),

(3) initial size,

(4) initial color,

(5) initial transparency,

(6) shape,

(7) lifetime.

Section 2.3 discloses particle dynamics.

52. Cohen discloses "*Computer animations, quantum mechanics and elementary particles.*" See entire disclosure. The following is from pg. 165;

"In a typical animation, starting from a small number of virtual particles, the number tends to increase as a function of time, signaling the deviation from the physical states. A physical particle contains a cloud of finite size of virtual particles. The animation actually allows us to see the formation of such clouds. It is rather amusing to identify dressed objects mainfesting collective behavior, and then analyze the space renormalization group of the clouds by zooming in."

On page 166, the following is found:

The visualization "dictionary" developed for computer animations of quantum systems ***can be applied to any process following the rules of one or several of Nature's fundamental interactions. Animation of various atomic and subatomic phenomena*** *such as electron orbitals, particle collisions, radiactive decay, fusion, fission, etc. are therefore feasible and instructive."*

53. Claims 1, 12, 16, 20 and 22-24 are rejected under 35 U.S.C. 102(e) as being anticipated by Kinema/SIM.

54. Kinema/SIM is a software tool that presents a simulation space for particle behavior where you can construct and animate complex physical phenomena. See entire disclosure. A number of features are subsequently listed for Applicant's benefit.

- Examples of the graphical interface are shown on pp. 1-8 to 1-9;
- the "particle window" is shown on pg. 2-7; here the particle parameters can be altered;
- "Lifetime" defines the particle lifetime (pg. 2-9);
- "particle geometry" is discussed on pg. 2-11;
- "coordinate systems" are discussed on pg. 3-3;
- entering particle parameter values via slider buttons (pg. 3-10;
- probibility functions for particle speed, lifetime, emission angles (pg. 3-11);
- other relevant temporal parameters (pg. 3-16);
- GUI simulation controls (pg. 5-2);
- statistical features (ie., *group behavior* - pg. 5-3);
- particles, obstacles (pg. 5-5);
- deatils about simulation parameter values including source rate, display, particle interactions and emission sources (chapter 6);
- range of interactions between particles (pg. 6-3);
- source rate (pg. 6-4);
- a combined particle (pg. 6-5), wherein

"The Euler mode, on the other hand, calculates forces more globally and therefore has the advantage of maintaining simulation speed. It calculates only one force per cell at time t, which is applied to all particles in the cell. ...";

- Chapter 7 discloses "Particles";

- particle coupling (pg. 7-1);

- particle examples (pg. 7-1), wherein

"Particles are the key element in Kinema/SIM simulations. They are point objects that can represent a broad range of physical and image characteristics such as mass, charge, color, motion and geometry. In your simulation, particles can represent a diversity of real or image objects such as quantum physics particles, gas molecules, aerosol droplets, bacteria, fluid flow, dust, rain, snow, sand, or pixels of images. The possibilities are as numerous as the phenomena of reality and creative animtion ...

... Particles are emitted into the simulation via sources which can be visible or invisible points or geometric objects positioned in simulation space. ...";

- particles parameter window (pg. 7-3 to 7-4);

- *"Sigma", a parameter related to particle-particle interactions* (pp. 7-13 to 7-14);

- decay particles (pg. 7-21);

- particle coupling (pp. 7-22 to 7-23);

- Chapter 8 (source parameters);

- sources (pg. 8-1), wherein

"Sources are orgins that emit particles into the simulation, and all particles must enter the simulation via a source. Sources can be points or have spatial geometry which you can choose to see or hide in simulation space. You can define as many sources as you like for a system, but each source is restricted to

emit only one particle type. (If you want to have more than one particle type originate from the same position, you can superimpose sources at the point. ...

... In the source window you assign a particle type to the source and then define the rate and speed of the particles along with their spread angle into the simulation. ..."

The "spread angle" is Applicant's "cone".;

- source window (pg. 8-3);
- source rate (pg. 8-4);
- **Spread** (pg. 8-5);
- speed (pg. 8-6);
- source position (pg. 8-10);
- display (pg. 8-11);
- geometry (pg. 8-13);
- particle emission and geometry (pp. 8-15 to 8-16);
- particle generation (pp. 8-16 to 8-17);
- Chapter 9 "Obstacles";
- Chapter 13, "electric fields";
- Chapter 15, "particle events";
- elastic and inelastic particle collisions (pp. 15-1 to 15-2);

Claim Rejections - 35 USC § 103

55. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

56. **Claims 2-11, 13-15, 17-19, 21, 25-26 and 28-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over [Ohira (Applicant - Applicant's IDS) or Yamada et al.] in view of (Kinema/SIM or Reeves or Cohen), and the taking of Official Notice.**

57. Ohira et al. discloses details of a Molecular-dynamics simulation of sputtering. See: abstract; pg. 2 (Theoretical Methods) and especially fig. 1.

58. Yamada et al. discloses details of a Monte Carlo simulation of sputtering. See entire disclosure. Especially note fig. 1-3.

59. [Ohira et al. or Yamada et al.] disclose all claim limitaions except for teaching animation of the simulation. Official notice is taken that it was obvious and well known to one of ordinary skill in the art at the time of the invention to animate simulations of physical processes. [Kinema/SIM or Reeves or Cohen] provide details about animations of particles.

60. The discloses of Reeves, Kinema/SIM and Cohen were presented earlier.

61. **Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over [Ohira et al. (Applicant - Applicant's IDS).] in view of (Kinema/SIM or Reeves or Cohen), and the taking of Official Notice.**

62. [<u>Ohira et al.</u>] discloses all claim limitaions (**<u>see fig. 1 - temperature control particles</u>**) except for a teaching animation of the simulation. Official notice is taken that it was obvious and well known to one of ordinary skill in the art at the time of the invention to animate simulations of physical processes. [Kinema/SIM <u>or</u> Reeves <u>or</u> Cohen] provide details about animations of particles.

Response to Arguments

63. Applicant's arguments filed 11/17/99 have been fully considered but they are not persuasive.

64. Applicant's <u>comments regarding reasons for allowance</u> have been carefully reviewed. The comments are not persausive. A brief history of the issue and the case is in order. The issue pertains to comments on page 9 of paper # 8 regarding Applicant's definition of "combined particle(s)", which were provided in response to Examiner's remarks paragraph 16 of paper # 6. There, the Examiner was trying to determine the meaning of the phrase, "combined particle";

> *"The following clarifications are requested in order to facilitate the examiner's understanding of the applicant's invention. As per claims 1-3, 5, 10, 12, 16-17, 20-24, and 32, it is not clear what the term "combined particle" means with respect to the following. First, with respect to a combined particle formed of only adsorbate particles, does this mean that the individual particles in the combined particle are interacting with each other (through, for example, van der Waals forces and thus the combination represents an underlying physical process) or is this just a fictitious representation which aids in reducing the complexity of the problem? Second, with respect to a combined particle formed of adsorbate*

> *particles and substrate particles, what is meant by this combination. Is it a combination in the sense of, for example, a polaron (again a physical criterion) or again a fictitious representation?"*

In paragraph 4 on page 9 of paper # 8, Applicant responded,

> *"First, a combined particle is formed of both substrate particles and adsorbate particles, not simply adsorbate particles as advocated by the Examiner. <u>The combination of a substrate particle and an adsorbate particle to form a combined particle</u> <u>**does not mean that the particles are interacting with one another. Rather, this is meant as a fictitious representation and is not intended as a physical criterion.**</u>"*

The claims were determined to be allowable over the prior art, <u>based on the above assertion</u>. As noted by Examiner, on pg. 3 of paper # 9,

> *"Baumann et al. disclosed the simulation of clusters wherein the clusters were composed of <u>interacting particles</u> (via dipole-dipole or other interparticle forces). Since the particles in applicant's disclosure are <u>not interacting</u>, the art rejection based on Baumann et al. is not applicable. Similarly, there are inter-particle interactions in the disclosure of Misaka et al., and thus, this also is not an applicable citation. The concept of fictitious particles has been disclosed previously (as noted by examiner in the last action - quasi-particles, effective mass electrons in periodic potentials, polarons, etc.), but the concept has apparently not been applied to combinations of substrate and adsorbate particles as per sputtering simulations. Since said "combined particle(s)" is present in each of the independent claims, all claims are allowable over the prior art."*

65. Applicant, pp. 13-14 of paper # 12 asserts that the statement, cited from paper # 8, was misinterpreted. Applicant subsequently abandoned the case and filed for a CPA. <u>The prior art rejection is therefore reinstated.</u> Furthermore, <u>other significant and relevant prior art has been</u>

obtained by the Examiner; as provided, above. For that reason, a first action rejection has not been provided (a first action rejection could have been provided since there was no significant amending of the claims in the CPA). In any case, the original question concerning the meaning of "combined particle" still stands. The meaning of the phrase is still not clear.

66. As per arguments pertaining to the original art rejection (paper # 6) as well as remarks by the Examiner concerning the teachings in the prior art (pp. 3-5 of paper # 9), Applicant has only asserted that, "*None of the cited references disclose such an emission source.*" Examiner respectfully *requests that Applicant point to specific instances in the prior art of record* where such a teaching is lacking or where there is a teaching away from Applicant's claims. Examiner has exerted a great deal of effort to provide Applicant with pertinent art and well reasoned arguments. Examiner has responded to Applicant's various requests; for example, Applicant has stated (pg. 11 of paper # 8),

> *"The Examiner's rejection of claims 4, 7, 13, 14, 15, 18, 19, and 22 is flawed in that he relies upon his own personal experience in rejecting these claims. For example, with respect to claim 18 and the display unit recited therein, the Examiner states in paragraph 38 of the Office Action that* ***"this is the standard in the art; I have seen this type of display at conferences ...*** *" It makes no difference what the Examiner has personally experienced if it does not qualify as prior art. Applicants traverse all such rejections of the claims noted above, the rejections of which are at least partially grounded on the Examiner's personal knowledge. That is, the Examiner is in effect stating that some of the claim limitations are well known in the art, without supplying a reference to back up his assertions. Instead, he supplies statements based on his personal knowledge such as the one quoted above. This is not acceptable to the Applicants, as the Examiner's personal knowledge may well be flawed and his memory inaccurate. Thus, Applicant's demand that the Examiner supply references or a declaration that supplies relevant dates and places so that Applicant can determine whether the Examiner is truly relying on prior art or whether the Examiner is relying upon "smoke and mirrors" to set forth a basis for rejecting the above claims."*

67. A few remarks are in order. The Examiner personally regrets the tone of the above quoted remarks. Furthermore, considering the Applicant's concerns about the Examiner's personal knowledge, it is noted that Applicant has not provided any remarks concerning the Examiner's publication, pertaining to particle simulation, in ***Physical Review***, which was provided for Applicant's benefit. Examiner's recollections were based on extensive experience in the field of particle simulation, and were provided for Applicant's benefit. This was challenged. In any case, said art was provided to Applicant. Moreover, it is also noted that, considering the Applicant's remarks quoted above, and in view of the art provided by the Examiner in response to Applicant's demand (paragraphs 7-8 of paper # 9), *there has been no substantial arguments or remarks directed at said demanded prior art.* In fact most of Applicant's remarks, have been directed at Examiner's recollections; there have been no substantial remarks directed at the prior art of record.

68. Again, Examiner has exerted a great deal of effort to provide Applicant with pertinent art and well reasoned arguments, and respectfully *requests that Applicant point to specific instances in the prior art of record* where a specific teaching is lacking or where there is a teaching away from Applicant's claims.

69. The remarks concerning the 101 rejection (pp. 11-13 of paper # 12) are not persuasive. As per the 101 rejection (papers # 6 and 9), it is still not clear what constitutes the end use of the invention. As per remarks (pg. 6 of paper # 8) concerning tangible results; what is the useful

result of simulating phenomena of a combined particle? These claims are directed abstract ideas without any useful application. Clearly, the specification is directed towards sputtering - however, this is not evident in the claims. As per remarks concerning the 112 (first) rejection (page 7 of paper # 6), since the claimed invention is not supported by either a asserted utility or a well established utility for the reasons set forth above, one skilled in the art clearly would not know how to use the claimed invention.

70. Please note the art rejection based on the Kinema/SDK reference manual. A copy of the reference was supplied with the advisory action (paper # 13). Please contact the Examiner immediately, if the Applicant does not have a copy.

Conclusion

71. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- **Bouvier et al.**: "*From crowd simulation to airbag deployment: particle systems, a new paradigm of simulation.*" This publication discloses details concerning the *Kinema/Sim* software package. The reference apparently does not qualify as prior art since the date of publication is 1/97. However, the reference compactly summarizes the matter disclosed in the Kinema/Sim manual and is provided for Applicant's benefit. See particularly: Section 1, including: section 1.1 (*Introduction and Objectives*), section 1.2 (*Particle Systems*), sections 1.2.1 and 1.22; Section 2 (*Particle Systems*), especially section 2.2, wherein:

"A particle system is defined by:

The description of the **particle types,**

The **particle sources which generate the sources,**

The **3D geometry, including obstacles,**

The **evolution of these particles** within the system";

section 2.2.2 wherein the particle object is defined, including, among others:

"its **values for interactions with surfaces** (stick, bounce, penetrate, transform, etc),

its **visualization parameters: color, size, transparency, trail memory, geometry**";

section 2.2.2 (***Generation of Particles***), wherein;

"Generating particles implies the description of an initial state for the system, by defining particles of different types, with imposed positions and velocities. During the simulation, the interaction of these particles with the system will change these initial values, but the **user will have the possibility to create new particles,** with defined position and velocities.

The particles are generated by sources. Sources are geometric entities emitting only one type of particle. They are defined by:

Their **position in the space and their dimension,**

Their size and **geometry,**

Their **rate of emission as a function of time,**

Their **direction of emission: a given vector, a local normal to a surface, or a given trajectory**";

section 2.2.3 (*Evolution of particles*); section 2.2.5 (*Advantages of the Kinema approach to particle systems*), wherein, among other things:

"the system can:

handle **collisions of particles with objects, surfaces** and <u>**with other particles**</u>,

manage the position of sources and emission parameters (rate, direction, speed)";

section 3.6 (*visualization*); and section 5 (*Further simulations under development*), wherein,

"Obstacles and source management facilites enable us to model different kinds of phantoms (scattering environment shapes and radioactive spatial distributions). ..."

- Ohta (U. S. Patent 5,751,607, Method (Sputter Deposition Simulation by Inverse Trajectory Calculation, 1998) discloses the use of Monte Carlo techniques as it pertains to the simulation of sputtering. [of record]

- Jones et al., "Monte Carlo Investigation of Electron-Impact Ionization in Liquid Xenon," Phys. Rev. B., 48, 9382-9387, 1993 teaches the use of Monte Carlo techniques as it pertains to electron transport in condensed media; references are provided to more details desciptions of Monte Carlo techniques. [of record]

- Takagi, "Development of New Materials by Ionized-Cluster Beam Technique," Mat. Res. Soc. Symp. Proc., 27, 501-511, 1984 discloses ion beam clusters ("combined particles") and its relation to deposition. [of record]

- Cornell Theory Center (1996) discloses an animated simulation of the dynamic failure of 3D solids under tension at the atomistic level using classical molecular dynamics and system sizes from 10 to more than 100 million atoms. [of record]

- XSIMBAD (1996) discloses a Monte Carlo simulation software package. A condition setting user template is shown on pp 3-4; animated simulation results are shown on pp. 5 and 11-12, graphical results are shown on pg. 6 and 11. [of record]

72. These references are a <u>few examples of many references which the examiner has obtained</u> concerning <u>animation as applied to simulation in general, and sputtering, in particular</u>.

73. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Hugh Jones whose telephone number is (703) 305-0023.

Dr. Hugh Jones

December 19, 1999